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No evidence for conspecificity between two high Andes *Liolaemus* lizards (Squamata: Liolaemidae)

Daniel Pincheira-Donoso

Laboratory of Evolutionary Ecology of Adaptations, School of Life Sciences, University of Lincoln, Brayford Campus, Lincoln, LN6 *7DL, Lincolnshire, United Kingdom.* E-mail: DPincheiraDonoso@lincoln.ac.uk

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Abstract. The remarkable taxonomic, ecological and geographic diversity achieved by the South American lizard genus *Liolaemus* has inspired persistent debate about species boundaries and the reliability of phenotypic predictors/indicators of reproductive isolation between species (i.e., signatures of speciation). Many aspects of these debates remain unsettled and part of the diversity of the genus remains under controversy. Factors such as small samples, or lack of molecular data to quantify genetic differences between species can be regarded as legitimate limitations on the ability to draw definite taxonomic conclusions. However, conclusions drawn from careless and negligent observations should be taken with high degree of caution. A recent paper offers a clear example of this latter scenario, in which it is suggested that *Liolaemus filiorum* Pincheira-Donoso and Ramirez, 2005 is a synonym of *Liolaemus puritamensis* Nuñez and Fox, 1989 based on qualitative analyses of the "holotype" of the former which is, in fact, not the holotype of this taxon, but rather one of the paratypes of the latter species. Editors and referees should play a central role in preventing publication of studies of this nature.

Keywords. *Liolaemus*, speciation, synonymy, taxonomy, integrative taxonomy.

The iguanian genus *Liolaemus* is one of the most species-rich groups of living vertebrates (Pincheira-Donoso et al., 2013a). The prolific adaptive radiation undergone by this lineage has resulted in 240+ species adapted to a remarkable diversity of ecological conditions, encompassing all climatic extremes found in central and southern South America, including deserts, tropical environments, and some of the highest elevations/latitudes recorded among reptiles globally (Morando et al., 2003; Espinoza et al., 2004; Schulte et al., 2004; Pincheira-Donoso et al., 2008, 2013b; Labra et al., 2009; Pincheira-Donoso, 2011; Pincheira-Donoso and Tregenza, 2011; Meiri et al., 2013). Not surprisingly, the causes and consequences, and the genetic and phenotypic expressions behind such diversity have been the focus of persistent debate and controversy (Morando et al., 2003, 2004; Pincheira-Donoso and Nuñez, 2005; Avila et al., 2006; Labra, 2011; Pincheira-Donoso, 2012). Opinions remain divergent, and debates remain unsettled.

In recent years, the development of the 'integrative taxonomy' approach has made explicit the need for taxonomic conclusions to be drawn from quantitative and multivariate analyses of the various components involved in the process of species formations, i.e., the search for signatures of speciation (Padial et al., 2009, 2010). This approach adds scientific objectivity to taxonomic conclusions, and has in fact increasingly been adopted by liolaemid researchers (Avila et al., 2006; Morando et al., 2007; Pincheira-Donoso et al., 2007; Breitman et al., 2011a, b; Morando et al., 2013; Scolaro et al., 2013). However, a recent study (Troncoso-Palacio, 2014) that proposed a conclusion with major implications (conspecificity between two species) not only employs a purely typological and qualitative analytical approach, but is based on a fundamental error. In this study, Troncoso-Palacio (2014) concludes that *Liolaemus puritamensis* Nuñez and Fox, 1989 and *L. filiorum* Pincheira-Donoso and Ramirez, 2005 are the same species (given the temporal priority of

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L. puritamensis, the latter taxon is treated as a subjective junior synonym of the former). This conclusion is based on comparisons between three specimens, two *L. puritamensis* and (as claimed by the author) the "holotype" of *L. filiorum*. Although the lack of a quantitative analytical approach and the extremely limited sample sizes may be viewed as inappropriate to support the hypothesis of conspecificity between these taxa, the very basic flaw that invalidates the conclusions of Troncoso-Palacio (2014) is that this "holotype" is not the holotype of *L. filiorum* but, in fact, one of the paratypes of *L. puritamensis* itself (Fig. 1). This specimen was recently transferred to the Museo Nacional de Historia Natural de Chile collection from another collection and erroneously given the same number, MNHN-3829, as the *L. filiorum* holotype, although the data accompanying the specimen clearly identify it as a paratype of *L. puritamensis*. By focusing on the museum collection number of the specimen rather than on details of locality, date and collectors provided in the original description of *L. filiorum*, Troncoso-Palacio compared specimens in the same type series and not surprisingly concluded that these specimens were conspecific. Thus, no evidence exists to conclude that these two *Liolaemus* are the same species. Here, I provide images of the real holo-

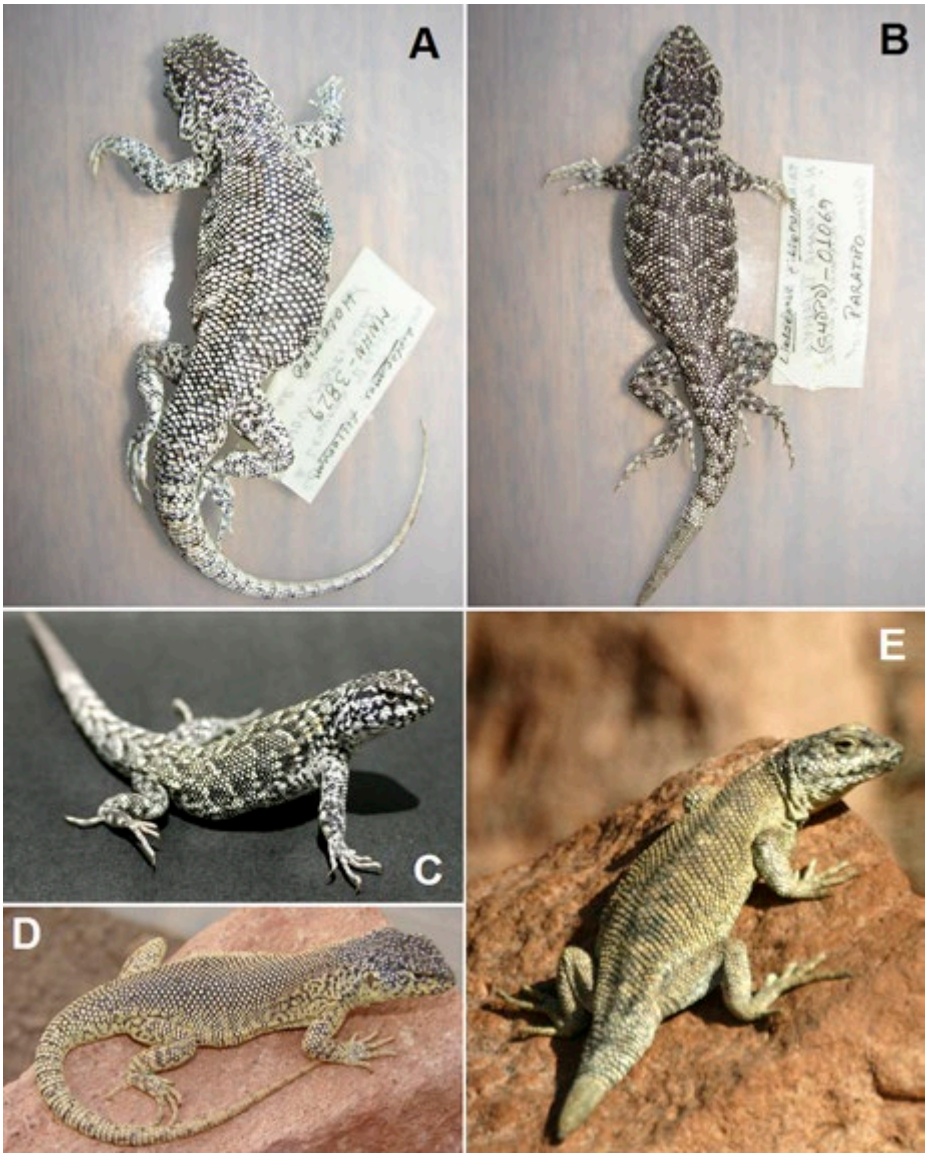

Fig. 1. *Liolaemus* from the High Andes of Chile. *Liolaemus filiorum*: Dorsal views of the holotype (A), paratype (B), and two living adult male specimens (C, D) from the type locality, Cerro Las Papas, Chile. *Liolaemus puritamensis*: A living specimen of from Vilaco, Chile (E).

type (MNHN-3829) and paratype (CHDPD-01069) of L. *filiorum*, and pictures of both species in life (Fig. 1).

Taxonomy has seen a tendency to be treated as a marginal discipline, especially in high-impact scientific journals, and has been considered the 'Cinderella' of biology (e.g., Padial and De la Riva, 2007). While this view disregards the overwhelmingly vital role of taxonomic research as the basis for understanding biodiversity, and thus for areas such as ecology and evolution (see Isaac et al., 2004, for a discussion), it is essential that taxonomists conduct this science with due care and scientific rigor. Taxonomy is a science and, as such, it depends on the use of scientific approaches to thoroughly and quantitatively test hypotheses (e.g., hypotheses of speciation events as the basis for recognizing different species, or evidence that the genomes of two species fail to show signals of speciation events, which can include phenotypic or genetic signals). In this context, it is crucial for editors, referees and colleagues to identify studies that do not employ such standards before they are approved for publication.

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